Amendments to the Specification

Please replace the paragraph on page 1, lines 7-9, with the following rewritten paragraph:

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This is a continuation of U.S. Application No. 09/362,806 filed on July 28, 1999, now U.S. Patent No. 6,364,829, issued April 2, 2002, which is a continuation-in-part of U.S. Application No. 09/238,664 filed January 26, 1999, now U.S. Patent No. 6,537,211, issued March 25, 2003, the entire contents of which are incorporated herein by reference.

Please replace the paragraph on page 6, lines 17-20, with the following rewritten paragraph:

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~~Figure~~ Figures 11a-11d are schematic diagrams of a preferred embodiment of the imaging system which integrates the UV-transmissive illumination guide into the endoscope and connects an external UV excitation source to a standard white light source with an adapter module.

Please replace the paragraph beginning on page 7, at line 22, and ending on page 8, at line 5 with the following rewritten paragraph:

A3

The system of the present invention uses only a single imaging detector at the distal end of the endoscope for acquiring normal color images, fluorescence images and visible reference images. The use of a camera at the distal end is made possible by using fluorescence excitation light at ultraviolet to deep violet wavelengths to which the CCD camera is insensitive or can be made insensitive using a fixed filter. This allows broadband collection of the resulting tissue autofluorescence from blue to red wavelengths, resulting in sufficient light for effective video signals without the need for additional image intensification. Fluorescence imaging in this fashion has been described in-vivo by Wang, et al. as described in U.S. Application No. 09/238,664, entitled "Fluorescence Imaging Endoscope" filed on January 26th, 1999, now U.S. Patent No. 6,537,211, issued March 25, 2003, the entire contents of which is incorporated herein by reference.

Please replace the paragraph on page 8, lines 6-18, with the following rewritten paragraph:

Previous autofluorescence imaging systems have depended upon imaging very weak fluorescence at red wavelengths to provide an image to compare with the fluorescence image taken at blue-green wavelengths. Additional image intensification is particularly necessary to provide a usable red fluorescence ~~images~~ image. The autofluorescence imaging system and method of the present invention avoids this expense and difficulty by supplying additional visible red light illumination to the tissue for the purpose of obtaining a reference image. To be effective, however, the UV excitation light and the visible reference light must be delivered to the tissue through a common optical guide and exit the same illumination aperture with the same angular distribution. This requires a careful design of the excitation and reference light source optics. The processing of the reference image includes other features, such as histogram analysis, to eliminate artifacts such as visible specular reflections which do not occur in fluorescence images.

Please replace the paragraph beginning on page 9, at line 11, and ending on page 10, at line 12 with the following rewritten paragraph:

Figures 2a and 2b show the general components of a preferred embodiment in which the excitation light and the visible reference light are delivered to the tissue through a separate fiberoptic probe. The fiberoptic probe 200 is passed through a biopsy channel of a standard video endoscope 202 with its tip finally placed at or near the distal tip of the endoscope 204. When a footswitch 206 is depressed by the clinician, the normal white light illumination from the endoscope's light source and video processor 208 is switched off with a shutter. This white light normally illuminates the tissue through the two fiberoptic illumination ports 210 and 212 on the distal tip of the endoscope. Simultaneously, a complementary shutter in the excitation and reference illumination source 214 is switched on so that excitation and reference light can pass through the fiberoptic probe 200. The excitation and reference light exits the tip of the fiberoptic probe 216 and illuminates the tissue 218. The video image detection system 220 transmits the resulting fluorescence image signal and reference image signal back through the endoscope 202 to the video processor 208 where they are converted into different color

channels R and ~~B)~~ B in a standard R,G,B National Television Standards Committee (NTSC) video format. These two channels are digitized with a video framegrabber in the computer system 222. The digitized fluorescence and reference images are processed together in real time to quantify image regions where the fluorescence is reduced compared to normal tissue. Reduced fluorescence is the primary indicator of dysplasia. Areas of the tissue which are likely to be dysplastic are highlighted with false color in a processed image of the tissue which is displayed on a computer monitor 224 and updated at a rate of up to 10 Hz. The preferred embodiment shown in Figures 3a and 3b is thus an add-on component to an existing endoscope/video processor system which only requires the addition of an internal shutter to the white light source in the endoscope ~~systems~~ system's video processor. For color-wheel (monochrome CCD) video endoscopes, the excitation light source 214 is constructed to provide sequential excitation and reference illumination as described in more detail hereinafter. For color-CCD video endoscopes the excitation light source 214 provides simultaneous excitation and reference illumination, also described in more detail hereinafter.

Please replace the paragraph beginning on page 11, at line 23, and ending on page 12, at line 13 with the following rewritten paragraph:

The normal illumination light is carried by a fiberoptic bundle 312 which extends through the length of the endoscope and bifurcates near its distal tip, terminating at apertures 308 and 310. A shutter 314 between the illumination source and the fiberoptic bundle, controlled by a digital signal 315, allows the white light illumination to be turned off without turning off the source lamp 316. In the type of endoscope shown, the normal color image is obtained by combining three, successive images taken with ~~red, green~~ red, green and blue light pulses provided by a rotating filter wheel 318. The CCD detector in this type of endoscope is sensitive to all wavelengths between 400 nm and 700 nm, but is insensitive to UV excitation wavelengths around 365 nm which are used to excite the autofluorescence. This is due both to the design of the silicon sensor array and to the choice of optical materials used to physically protect the surface of the array. The CCD detector continuously integrates all of the light which falls on its surface so the illumination must be shuttered off while the CCD rows are shifted down to the readout electronics or else a streaking effect will be seen on the image. The red, green and blue

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light pulses have a duration of about 6 ms followed by a dark period of 5 ms during which the camera pixels are read out, yielding a total video frame period of about 33 ms or 29.97 frames per second to meet the NTSC standard. The analog readout signal form the CCD camera is carried through a cable 320 to the endoscope video processor 322.

Please replace the paragraph on page 12, lines 14-26 with the following rewritten paragraph:

The three successive monochrome images are digitized and combined into a standard color video signal at the end of the video frame. The processor has two groups of standard red, green, blue (RGB) plus synchronization outputs. One output group of color signals 324 goes to the ~~endoscopes~~ endoscope's video monitor 326 to display the normal color image of the tissue 328. Another group of color signals 330 goes to a video framegrabber 332 in the fluorescence imaging computer system 334 which will acquire and process the autofluorescence and reference images. A standard composite color signal output 336 from the video processor goes to a synchronization circuit 338, based on a National LM1881 Video Sync Separator. This synchronization circuit 338 determines when the interlaced even and odd fields occur in the video signal and outputs a binary digital signal 340 which is high during the odd field and low during the even field. This signal 340 is used throughout the fluorescence imaging system to synchronize its functions to the timing set by the endoscope's video processor.

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Please replace the paragraph on page 13 lines 13-25 with the following rewritten paragraph:

The excitation and reference light pulses must occur during two of the three normal illumination pulse periods for the autofluorescence and reference images to be properly acquired. These images appear on the next video output frame on two of the three video output channels from the endoscope video processor. The appropriate timing is accomplished by rotating shutters 352 and 354 in the excitation (UV) and reference (RED) light paths, respectively, of the optical group 350. The shutters are driven by direct current (DC) motors 356 and 358 which rotate at a speed which can be controlled by varying their supply voltage. A fiducial hole near the rim of the shutters, combined with an optical source and detector, generates a reference pulse for each which marks its phase

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as it rotates. A phase-locked loop (PLL) 362 and 360 for each motor, 358 and 356, respectively, adjusts the ~~motors~~ motor's voltage so that the reference pulse for each matches the rising edge of the synchronization pulse 340 marking the beginning of the odd video field.